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PIEZOELECTRIC CERAMIC COMPOSITION AND ITS PRODUCTION

Abstract:

PROBLEM TO BE SOLVED: To obtain a piezoelectric ceramic composition capable of being produced at a low firing temperature so as to control deviation or fluctuation of the composition resulting from evaporation of lead oxide by making the composition include a specific content of AgO as an auxiliary ingredient in a compound oxide of Pb, Zn, Nb, Sn, Ti and Zr as the main ingredient.

SOLUTION: This piezoelectric ceramic composition comprises a compound oxide as the main ingredient and 0.02 to 2.5 wt.% (based on the main ingredient) of AgO as an auxiliary ingredient, the former being shown by the formula $Zn_{1/3}Nb_{2/3}A(Sn_{1/3}Nb_{2/3})B(TiCrDO_3 [0.01 \leq A \leq 0.55; 0.01 \leq B \leq 0.25; 0 \leq C \leq 0.80; 0 \leq D \leq 0.88; \text{ and } A+B+C+D=1])$. It exhibits greatly improved dielectric constant, coupling coefficient and particularly mechanical Q level, when further incorporated with 0.05 to 5 wt.% of Cr₂O₃ or MnO₂, based on the main ingredient, as another auxiliary ingredient. A piezoelectric ceramic composition is obtained by firing the composition comprising the main ingredient shown by the above formula and 0.02 to 2.5 wt.% (based on the main ingredient) of powdered AgO as the auxiliary ingredient, after it is formed into a shape.

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AIMS

aim(s)]

aim 1] The piezoelectric-ceramics constituent which uses $\text{Pb}(\text{Zn}_{1/3}\text{Nb}_{2/3})\text{A}(\text{Sn}_{1/3}\text{Nb}_{2/3})\text{BTiCZrDO}_3$ (however, $0 \leq A \leq 0.55$, $0.01 \leq B \leq 0.25$, $0 \leq C \leq 0.80$, $0 \leq D \leq 0.88$, $A+B+C+D=1$) as a principal component, and is characterized by containing AgO 0.02 to 2.5% of the weight to this principal component as an accessory constituent.

aim 2] The piezoelectric-ceramics constituent according to claim 1 characterized by containing MnO_2 0.05 to 5% of weight to a principal component as an accessory constituent further.

aim 3] The piezoelectric-ceramics constituent according to claim 1 characterized by containing Cr_2O_3 0.05 to 5% of weight to a principal component as an accessory constituent further.

aim 4] Principal component $\text{Pb}(\text{Zn}_{1/3}\text{Nb}_{2/3})\text{A}(\text{Sn}_{1/3}\text{Nb}_{2/3})\text{BTiCZrDO}_3$ To ($0.01 \leq A \leq 0.55$, $0.01 \leq B \leq 0.25$, $0 \leq C \leq 0.80$, $0 \leq D \leq 0.88$, $A+B+C+D=1$) [however,] The manufacture approach of the piezoelectric-ceramics constituent equipped with the 1st process which adds Ag powder 0.02 to 2.5% of the weight to said principal component as an accessory constituent, and forms a Plastic solid, and the 2nd process which calcinates said Plastic solid next.

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TAILED DESCRIPTION

tailed Description of the Invention]

01]

ld of the Invention] This invention relates to the piezoelectric-ceramics constituent in which low-temperature baking possible, and its manufacture approach.

02]

scription of the Prior Art] $\text{Pb}(\text{Zn}_{1/3}\text{Nb}_{2/3})\text{A}(\text{Sn}_{1/3}\text{Nb}_{2/3})\text{BTiCZrDO}_3$ (it indicates to JP,52-17239,B and JP,51-8,B) is known as a piezoelectric-ceramics constituent. This constituent is the piezoelectric material which has the criptions, like that the diameter of crystal grain is small, and a mechanical strength is large, and is the outstanding zoelectric-ceramics ingredient which can respond to high power vibrator, such as a piezoelectric transformer, while zoelectric is excellent. Moreover, these constituents can obtain the piezoelectric ceramics of various properties ording to an application by choosing the presentation ratio of a component. These piezoelectric-ceramics constituents used for a piezo-electric buzzer, the piezo-electric ignition plug, the ceramic filter, the RF radiator, the ultrasonic rator, etc.

03]

blem(s) to be Solved by the Invention] However, this piezoelectric-ceramics constituent generates Pb_2SnO_4 phase he time of baking, and in order that this may check sintering, sintering temperature becomes high with 1200-1300 rees C. It had the trouble of scattering of lead oxide having been remarkable at the time of baking, and as a result ducing fluctuation and dispersion of a presentation at it.

04] Then, this invention aims at offering the piezoelectric-ceramics constituent in which low-temperature baking is sible in order to control dispersion in the presentation gap and presentation by scattering of lead oxide.

05]

ans for Solving the Problem] In order to attain this object the piezoelectric-ceramics constituent of this invention $\text{Pb}_{1/3}\text{Nb}_{2/3})\text{A}(\text{Sn}_{1/3}\text{Nb}_{2/3})\text{BTiCZrDO}_3$ ($0.01 \leq A \leq 0.55$, $0.01 \leq B \leq 0.25$, $0 \leq C \leq 0.80$, $0 \leq D \leq 0.88$, $B+C+D=1$) are used as a principal component. [however,] When it is characterized by containing AgO 0.02 to 2.5% he weight to this principal component as an accessory constituent and the reaction of Pb_2SnO_4 phase and Ag nponent which are generated at the time of baking promotes a sintering rate substantially, low temperature sintering 0 degrees C or less is made possible.

06]

nbodiment of the Invention] Invention of this invention according to claim 1 $\text{Pb}(\text{Zn}_{1/3}\text{Nb}_{2/3})\text{A}(\text{Sn}_{1/3}\text{Nb}_{2/3})\text{iCZrDO}_3$ ($0.01 \leq A \leq 0.55$, $0.01 \leq B \leq 0.25$, $0 \leq C \leq 0.80$, $0 \leq D \leq 0.88$, $A+B+C+D=1$) are used as a principal nponent. [however,] It is the piezoelectric-ceramics constituent characterized by containing AgO 0.02 to 2.5% of weight to this principal component as an accessory constituent, and burning temperature can be reduced remarkably, ttering of the lead oxide under baking decreases by this, and presentation fluctuation and dispersion can be lessened.

07] Invention according to claim 2 is a piezoelectric-ceramics constituent according to claim 1 characterized by itaining MnO_2 0.05 to 5% of the weight to a principal component as an accessory constituent further, and a dielectric istant, a coupling coefficient, especially its mechanical Q improve substantially.

08] Invention according to claim 3 is a piezoelectric-ceramics constituent according to claim 1 characterized by itaining Cr 2O_3 0.05 to 5% of the weight to a principal component as an accessory constituent further, and a lectric constant, a coupling coefficient, especially its mechanical Q improve substantially.

09] Invention according to claim 4 Principal component $\text{Pb}(\text{Zn}_{1/3}\text{Nb}_{2/3})\text{A}(\text{Sn}_{1/3}\text{Nb}_{2/3})\text{BTiCZrDO}_3$ To $0.01 \leq A \leq 0.55$, $0.01 \leq B \leq 0.25$, $0 \leq C \leq 0.80$, $0 \leq D \leq 0.88$, $A+B+C+D=1$) [however,] It is the manufacture roach of the piezoelectric-ceramics constituent equipped with the 1st process which adds Ag powder 0.02 to 2.5% of

weight to said principal component as an accessory constituent, and forms a Plastic solid, and the 2nd process which inates said Plastic solid next, and low-temperature baking at 1100 degrees C or less is attained.

10] It explains referring to a drawing about the gestalt of 1 operation of this invention below.

stalt 1 of operation) PbO, ZnO, SnO₂, Nb 2O₅, and TiO₂ and ZrO₂ were used as a raw material, and the principal iponent which becomes Pb(Zn_{1/3}Nb _{2/3}) 0.09 (Sn_{1/3}Nb _{2/3}) 0.09Ti_{0.44}Zr_{0.38}O₃ was obtained. Next, Ag, AgO, O₂, and Cr 2O₃ were used as an accessory constituent, and after carrying out weighing capacity so that it may ome the presentation ratio which shows these to a principal component (table 1), temporary quenching of what was ed with the ball mill was carried out at 900 degrees C for 2 hours.

11]

able 1]

添加量, wt %				焼成	誘電	結合	機 械
MnO ₂	Cr ₂ O ₃	Ag	AgO	温度 ℃	率	係数 k 31	的 Q m
---	---	---	---	1180	2000	0.371	60
---	---	0.02	---	1070	2010	0.38	58
---	---	0.1	---	1040	2100	0.381	55
---	---	0.5	---	1000	2080	0.38	62
---	---	2.0	---	1000	2200	0.377	59
---	---	---	0.02	1070	2050	0.379	55
---	---	---	0.1	1040	2100	0.38	64
---	---	---	0.5	1020	2200	0.383	55
---	---	---	2.0	1000	2250	0.379	58
0.5	---	---	---	1150	1350	0.35	1900
0.5	---	0.02	---	1050	1380	0.361	2000
0.5	---	0.1	---	1040	1390	0.358	2200
0.5	---	0.5	---	1010	1400	0.357	2038
0.5	---	2.0	---	1000	1400	0.355	2000
0.5	---	---	0.02	1050	1378	0.360	2020
0.5	---	---	0.1	1040	1380	0.362	2200
0.5	---	---	0.5	1010	1410	0.361	2150
0.5	---	---	2.0	1000	1390	0.358	2130
---	0.5	---	---	1140	1490	0.335	1650
---	0.5	0.02	---	1030	1550	0.342	1800
---	0.5	0.1	---	1000	1532	0.343	1900
---	0.5	0.5	---	970	1520	0.342	1830
---	0.5	2.0	---	970	1540	0.339	1890
---	0.5	---	0.02	1030	1510	0.340	1880
---	0.5	---	0.1	1000	1546	0.339	1900
---	0.5	---	0.5	970	1540	0.338	1920
---	0.5	---	2.0	970	1532	0.339	1935

* 印は本発明の請求の範囲外で比較例

12] Then, it pulverized so that mean particle diameter might be set to 0.2 micrometers using a medium stirrer mill. diameter of 20mm and the about [thickness 1mm] disc-like Plastic solid were produced by the obtained fine icles, and this was calcinated for 2 hours at the temperature shown in (a table 1). After grinding the obtained celain in thickness of about 0.5mm after baking, the vacuum evaporationno electrode of Cr-Au was applied to the 1 sides. Then, 3kV [/mm] direct-current electric field were impressed to this component for 30 minutes between two trodes in the 150-degree C silicone oil, and polarization processing was carried out. A dielectric constant, a coupling fficient, and mechanical Q were measured about this sample. In addition, burning temperature is temperature from ch sintered density becomes max. A measurement result is shown in (a table 1).

13] Compared with that to which the piezoelectric-ceramics constituent of this invention which carried out little ition of Metal Ag or the AgO does not add these, burning temperature falls remarkably so that clearly from (a table

In the presentation whose addition of Ag and AgO is 0.1 - 1 % of the weight, while lowering of burning temperature is remarkable, it was admitted that a dielectric constant and a coupling coefficient increased. Moreover, with the piezoelectric-ceramics constituent which added MnO₂ or Cr₂O₃, mechanical Q increases to a principal component and lowering of the burning temperature by Ag or AgO addition.

14] In addition, the effectiveness of lowering of the burning temperature by temporary-quenching order of addition of Ag or AgO was the same. Moreover, instead of Ag or AgO, Ag compound from which Ag component is obtained by firing, such as a carbonate, a hydroxide, and a nitrate, may be used. In case the laminating components which furthermore really calcinate an internal electrode and a piezoelectric-ceramics constituent using the piezoelectric-ceramics constituent of this invention are produced, for example, when using Ag as an internal electrode, the concordance of an internal electrode and a piezoelectric-ceramics constituent becomes good by using metal Ag powder and an Ag component added to a piezoelectric-ceramics constituent.

15] Moreover, the various additives of NiO, CoO, and aluminum₂O₃ grade may be contained to the principal component of this invention.

16] In addition, in the basic presentation shown by $Pb(Zn^{1/3}Nb^{2/3})A(Sn^{1/3}Nb^{2/3})BTiCZrDO_3$, the constituent in the limits shown by $0.01 \leq A \leq 0.55$, $0.01 \leq B \leq 0.25$, $0 \leq C \leq 0.80$, and $0 \leq D \leq 0.88$ shows piezoelectric comparatively big], and is desirable as a piezoelectric-ceramics ingredient.

17] Moreover, in the constituent of the range where the addition of MnO₂ exceeds 5 % of the weight, piezoelectric sintering becomes remarkable. MnO₂ may use what kind of Mn compound, as long as Mn component is obtained by firing, such as a carbonate, a hydroxide, and a nitrate, especially MnCO₃ is excellent in dispersibility, and mixing is to carry out it.

18] Moreover, in the constituent of the range where the addition of Cr₂O₃ exceeds 5 % of the weight, piezoelectric sintering becomes remarkable. Cr₂O₃ may use what kind of Cr compound, as long as Cr component is obtained by firing, such as a carbonate, a hydroxide, and a nitrate.

19] When the addition of Ag or AgO is less than 0.02 % of the weight, lowering of burning temperature is small, and the dielectric constant or a coupling coefficient falls greatly, namely, piezoelectric falls remarkably when exceeding 0.02 % of the weight, the addition of Ag or AgO has desirable 0.02-% of the weight or more 2.5 or less % of the weight range.

20]

[Effect of the Invention] Above, according to this invention, when the reaction of Pb₂SnO₄ phase and Ag component which are generated at the time of baking promotes a sintering rate substantially, low temperature sintering 1100 degrees C or less is made possible.

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最終頁に続く

(54) 【発明の名称】 圧電磁器組成物とその製造方法

(57) 【要約】

【課題】 低温焼成が可能な圧電磁器組成物を提供することを目的とする。

【解決手段】 $Pb(Zn_{1/3}Nb_{2/3})_A(Sn_{1/3}Nb_{2/3})_BTiCZrD_3$ (ただし、 $0.01 \leq A \leq 0.5$, $0.01 \leq B \leq 0.25$, $0 \leq C \leq 0.80$, $0 \leq D \leq 0.88$, $A+B+C+D=1$) を主成分とし、副成分としてこの主成分に対して AgO を $0.02 \sim 2.5$ 重量%含有したことを特徴とする。

【特許請求の範囲】

【請求項1】 $Pb(Z_{n1/3}Nb_{2/3})_A(S_{n1/3}Nb_{2/3})_B(TiCZrD)_3$ (ただし、 $0.01 \leq A \leq 0.55$, $0.01 \leq B \leq 0.25$, $0 \leq C \leq 0.80$, $0 \leq D \leq 0.88$, $A+B+C+D=1$) を主成分とし、副成分としてこの主成分に対して AgO を $0.02 \sim 2.5$ 重量%含有したことを特徴とする圧電磁器組成物。

【請求項2】 副成分として、さらに MnO_2 を主成分に対して $0.05 \sim 5$ 重量%含有したことを特徴とする請求項1に記載の圧電磁器組成物。

【請求項3】 副成分として、さらに Cr_2O_3 を主成分に対して $0.05 \sim 5$ 重量%含有したことを特徴とする請求項1に記載の圧電磁器組成物。

【請求項4】 主成分 $Pb(Z_{n1/3}Nb_{2/3})_A(S_{n1/3}Nb_{2/3})_B(TiCZrD)_3$ (ただし、 $0.01 \leq A \leq 0.55$, $0.01 \leq B \leq 0.25$, $0 \leq C \leq 0.80$, $0 \leq D \leq 0.88$, $A+B+C+D=1$) に、副成分として前記主成分に対して Ag 粉末を $0.02 \sim 2.5$ 重量%添加して成形体を形成する第1の工程と、次に前記成形体を焼成する第2の工程とを備えた圧電磁器組成物の製造方法。

【発明の詳細な説明】

【0001】

【発明の属する技術分野】 本発明は、低温焼成が可能な圧電磁器組成物とその製造方法に関するものである。

【0002】

【従来の技術】 圧電磁器組成物として $Pb(Z_{n1/3}Nb_{2/3})_A(S_{n1/3}Nb_{2/3})_B(TiCZrD)_3$ (特公昭52-17239号公報、特公昭51-7318号公報に記載) が知られている。この組成物は圧電性が優れているとともに結晶粒径が小さいこと、機械的強度が大きいことなどの特徴を有する圧電材料で、圧電トランスなどハイパワー振動子に対応できる優れた圧電磁器材料である。また、これらの組成物は成分の組成比を選ぶことにより、用途に応じた種々の特性の圧電磁器を得ることができる。これらの圧電磁器組成物は圧電プザー、圧電点火栓、セラミックフィルタ、高周波発振子、超音波振動子等に用いられている。

【0003】

【発明が解決しようとする課題】 しかしながら、この圧電磁器組成物は、焼成時に Pb_2SnO_4 相を生成し、これが焼結を阻害するために焼結温度が $1200 \sim 1300^\circ C$ と高くなる。その結果焼成時に酸化鉛の飛散が著しく、組成の変動やばらつきを生じるという問題点を有していた。

【0004】 そこで、本発明は酸化鉛の飛散による組成ずれや組成のばらつきを抑制するために低温焼成が可能な圧電磁器組成物を提供することを目的とするものである。

【0005】

【課題を解決するための手段】 この目的を達成するために本発明の圧電磁器組成物は、 $Pb(Z_{n1/3}Nb_{2/3})_A(S_{n1/3}Nb_{2/3})_B(TiCZrD)_3$ (ただし、 $0.01 \leq A \leq 0.55$, $0.01 \leq B \leq 0.25$, $0 \leq C \leq 0.80$, $0 \leq D \leq 0.88$, $A+B+C+D=1$) を主成分とし、副成分としてこの主成分に対して AgO を $0.02 \sim 2.5$ 重量%含有したことを特徴とするものであり、焼成時に生成する Pb_2SnO_4 相と Ag 成分との反応が焼結速度を大幅に促進することにより、 $1100^\circ C$ 以下での低温焼結を可能にするものである。

【0006】

【発明の実施の形態】 本発明の請求項1記載の発明は、 $Pb(Z_{n1/3}Nb_{2/3})_A(S_{n1/3}Nb_{2/3})_B(TiCZrD)_3$ (ただし、 $0.01 \leq A \leq 0.55$, $0.01 \leq B \leq 0.25$, $0 \leq C \leq 0.80$, $0 \leq D \leq 0.88$, $A+B+C+D=1$) を主成分とし、副成分としてこの主成分に対して AgO を $0.02 \sim 2.5$ 重量%含有したことを特徴とする圧電磁器組成物であり、焼成温度を著しく低下させることができ、これにより焼成中の酸化鉛の飛散が少なくなり、組成変動やばらつきを少なくできるものである。

【0007】 請求項2に記載の発明は、副成分として、さらに MnO_2 を主成分に対して $0.05 \sim 5$ 重量%含有したことを特徴とする請求項1に記載の圧電磁器組成物であり、誘電率、結合係数、特に機械的Qが大幅に向上したものである。

【0008】 請求項3に記載の発明は、副成分として、さらに Cr_2O_3 を主成分に対して $0.05 \sim 5$ 重量%含有したことを特徴とする請求項1に記載の圧電磁器組成物であり、誘電率、結合係数、特に機械的Qが大幅に向上したものである。

【0009】 請求項4に記載の発明は、主成分 $Pb(Z_{n1/3}Nb_{2/3})_A(S_{n1/3}Nb_{2/3})_B(TiCZrD)_3$ (ただし、 $0.01 \leq A \leq 0.55$, $0.01 \leq B \leq 0.25$, $0 \leq C \leq 0.80$, $0 \leq D \leq 0.88$, $A+B+C+D=1$) に、副成分として前記主成分に対して Ag 粉末を $0.02 \sim 2.5$ 重量%添加して成形体を形成する第1の工程と、次に前記成形体を焼成する第2の工程とを備えた圧電磁器組成物の製造方法であり、 $1100^\circ C$ 以下での低温焼成が可能となるものである。

【0010】 以下本発明の一実施の形態について図面を参照しながら説明する。

(実施の形態1) 原料として PbO , ZnO , SnO_2 , Nb_2O_5 , TiO_2 , ZrO_2 を使用し、 $Pb(Z_{n1/3}Nb_{2/3})_{0.09}(S_{n1/3}Nb_{2/3})_{0.09}Ti_{0.44}Zr_{0.38}O_3$ なる主成分を得た。次に副成分として Ag , AgO , MnO_2 , Cr_2O_3 を使用し、これらを主成分に対して(表1)に示す組成比となるように秤量した後、ボールミルで混合したものを $900^\circ C$ で2時間仮焼した。

【0011】

【表1】

No	添加量, wt %				焼成	誘電	結合	機械
	MnO ₂	Cr ₂ O ₃	Ag	AgO	温度 ℃	率	係数 k31	的Qm
1*	---	---	---	---	1180	2000	0.371	60
2	---	---	0.02	---	1070	2010	0.38	58
3	---	---	0.1	---	1040	2100	0.381	55
4	---	---	0.5	---	1000	2080	0.38	62
5	---	---	2.0	---	1000	2200	0.377	59
6	---	---	---	0.02	1070	2050	0.379	55
7	---	---	---	0.1	1040	2100	0.38	64
8	---	---	---	0.5	1020	2200	0.383	55
9	---	---	---	2.0	1000	2250	0.379	58
10*	0.5	---	---	---	1150	1350	0.35	1800
11	0.5	---	0.02	---	1050	1380	0.361	2000
12	0.5	---	0.1	---	1040	1390	0.358	2200
13	0.5	---	0.5	---	1010	1400	0.357	2038
14	0.5	---	2.0	---	1000	1400	0.355	2000
15	0.5	---	---	0.02	1050	1378	0.360	2020
16	0.5	---	---	0.1	1040	1380	0.362	2200
17	0.5	---	---	0.5	1010	1410	0.361	2150
18	0.5	---	---	2.0	1000	1390	0.358	2130
19*	---	0.5	---	---	1140	1490	0.335	1650
20	---	0.5	0.02	---	1030	1550	0.342	1800
21	---	0.5	0.1	---	1000	1532	0.343	1900
22	---	0.5	0.5	---	970	1520	0.342	1830
23	---	0.5	2.0	---	970	1540	0.339	1890
24	---	0.5	---	0.02	1030	1510	0.340	1880
25	---	0.5	---	0.1	1000	1546	0.339	1900
26	---	0.5	---	0.5	970	1540	0.338	1920
27	---	0.5	---	2.0	970	1532	0.339	1935

*印は本発明の請求の範囲外で比較例

【0012】その後、媒体攪拌ミルを用いて平均粒径が0.2 μ mになるように微粉碎した。得られた粉体で直径20mm、厚み1mm程度の円板状の成形体を作製し、これを(表1)に示す温度で2時間焼成した。焼成後、得られた磁器を厚さ0.5mm程度に研磨した後、その両面にCr-Auの蒸着電極を塗布した。その後、この素子に150℃のシリコンオイル中で、両電極間に3kV/mmの直流電界を30分間印加し、分極処理した。この試料について誘電率、結合係数、機械的Qを測定した。なお、焼成温度は焼結密度が最大になる温度である。測定結果を(表1)に示す。

【0013】(表1)から明らかなように、金属AgもしくはAgOを少量添加した本発明の圧電磁器組成物は、これらを添加しないものに比べて焼成温度が著しく低下する。AgおよびAgOの添加量が0.1~1重量%の組成では、焼成温度の低下が著しいとともに、誘電率や結合係数が増加することが認められた。また、主成分にMnO₂もしくはCr₂O₃を添加した圧電磁器組成

物では、AgもしくはAgO添加による焼成温度の低下とともに、機械的Qが増加する。

【0014】なお、AgもしくはAgOの添加は、仮焼前後による焼成温度の低下の効果は同様であった。またAgあるいはAgOの代わりに、炭酸塩、水酸化物、硝酸塩など加熱によりAg成分が得られるAg化合物を用いてもよい。さらに本発明の圧電磁器組成物を用いて内部電極と圧電磁器組成物とを一体焼成する積層部品を作製する際は、例えば内部電極としてAgを用いる場合、圧電磁器組成物に添加するAg成分としては金属Ag粉末を用いることにより、内部電極と圧電磁器組成物とのなじみが良くなる。

【0015】また本発明の主成分に対して、NiO、CoO、Al₂O₃等の種々の添加物を含有してもよい。

【0016】なお、Pb(Zn^{1/3}Nb^{2/3})_A(Sn^{1/3}Nb^{2/3})_BTiCZrD₃O₃で示される基本組成において、0.01 ≤ A ≤ 0.55, 0.01 ≤ B ≤ 0.25, 0 ≤ C ≤ 0.80, 0 ≤ D ≤ 0.88で示される範

囲内の組成物が、比較的大きな圧電性を示し、圧電磁器材料として好ましい。

【0017】また、 MnO_2 の添加量が5重量%を越える範囲の組成物では圧電性の低下が著しくなる。 MnO_2 は炭酸塩、水酸化物、硝酸塩など加熱によりMn成分が得られるものであればどのようなMn化合物を用いても良く、特に $MnCO_3$ は分散性に優れており、混合がしやすい。

【0018】また、 Cr_2O_3 の添加量が5重量%を越える範囲の組成物では圧電性の低下が著しくなる。 Cr_2O_3 は炭酸塩、水酸化物、硝酸塩など加熱によりCr成分が得られるものであればどのようなCr化合物を用い

ても良い。

【0019】AgもしくはAgOの添加量が0.02重量%未満の場合、焼成温度の低下が小さく、2.5重量%を越える場合は誘電率もしくは結合係数が大きく低下し、すなわち圧電性が著しく低下するため、AgもしくはAgOの添加量は0.02重量%以上2.5重量%以下の範囲が好ましい。

【0020】

【発明の効果】以上本発明によると、焼成時に生成する Pb_2SnO_4 相とAg成分との反応が焼結速度を大幅に促進することにより、1100℃以下での低温焼結を可能にするものである。

フロントページの続き

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